



USER GUIDE

RADDS

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Version 1

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Max3dshop
<http://max3dshop.org>



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1 Introduction

1.1 RADDs

The RADDs-Board provides the following connectivity's:

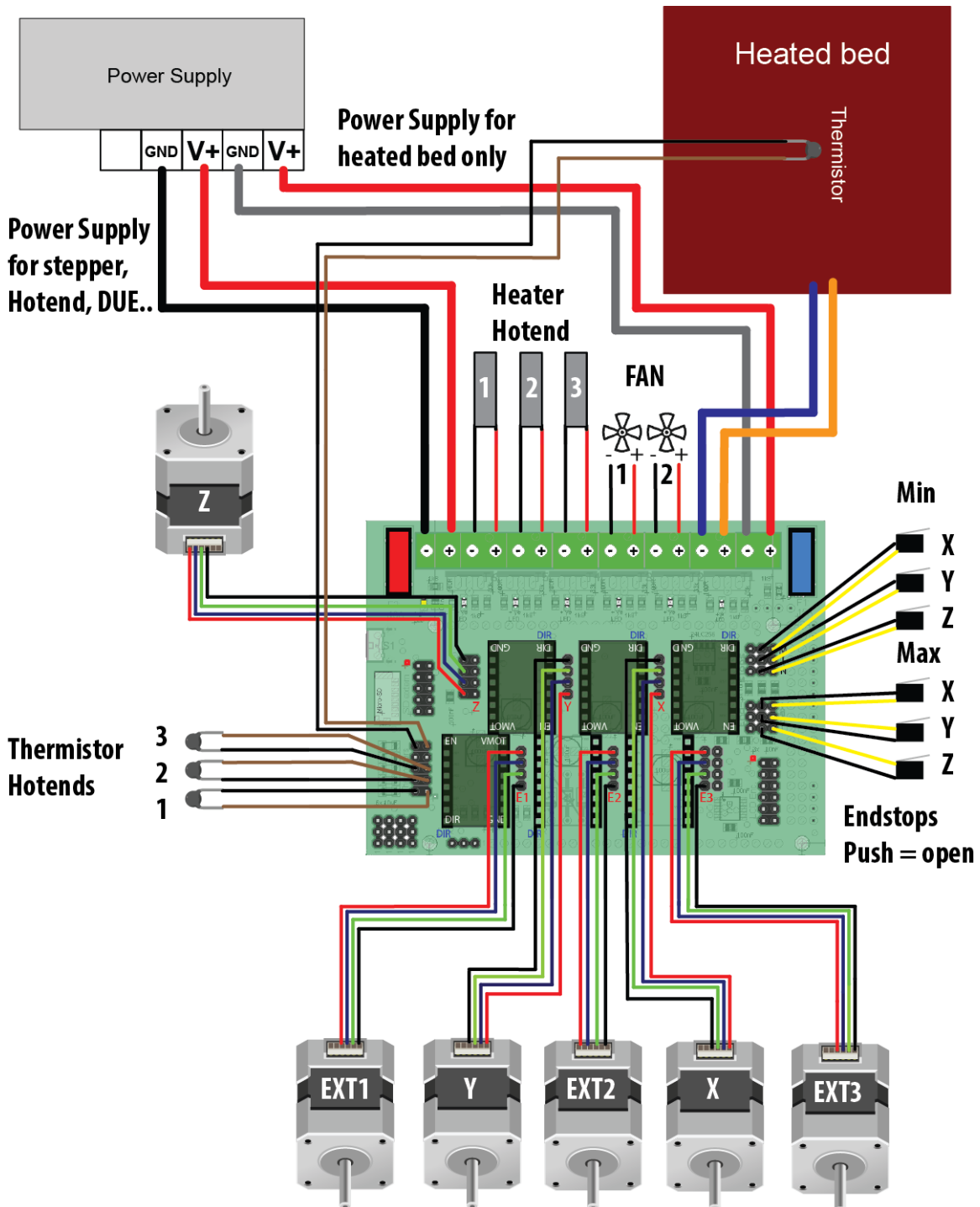
- 6 Steppers: e.g. 3 axis and 3 extruders (2 of the driver sockets are fitted with 2pin strips)
- 6 High-current loads: e.g. 1 HeatBed, 3 HotEnds and 2 fans
- SD-Card (micro-SD-slot onboard, optional external SD-slot)
- Standard LCD (5V) with 4x20 characters (HD44780 compatible)
- Rotating encoder (on LCD panel)
- 6 endstops
- 5 thermistors and a ADC
- 3 servo motors
- I2C, SPI, CAN, DAC, RS232 and 8 digital-pins available via pin strips

Additional Features:

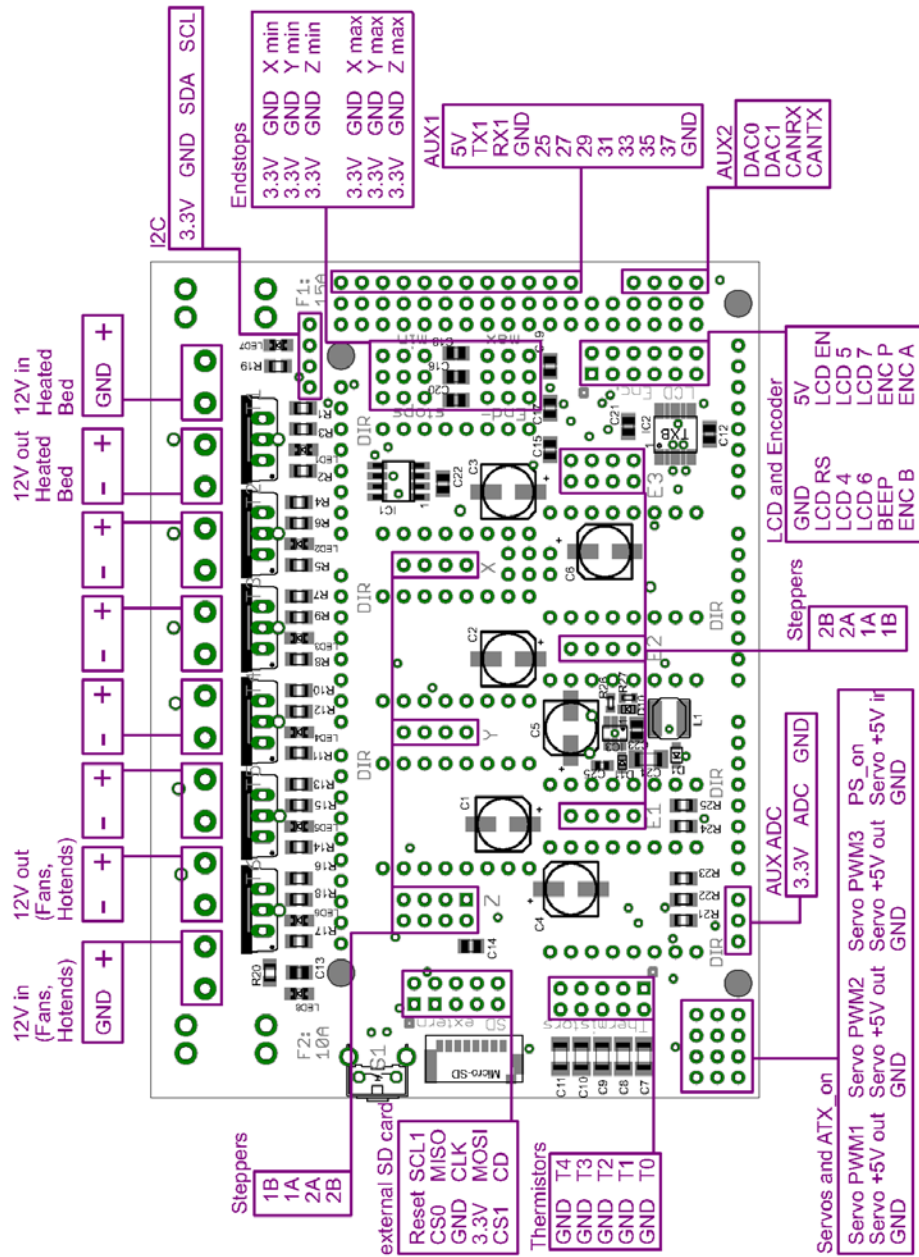
- EEPROM
- Control-LEDs for loads and operation voltage
- Catch-diodes at the FETs
- Car-fuses instead of thermo fuses
- Operation with 24V possible (Diode D1 has to be replaced by three 4V,1.3W zener-diodes)
- Heatbed-current can be up to 15A without a heat sink
- Premium screw terminals

2 Wiring and configuration

2.1 Wiring diagram

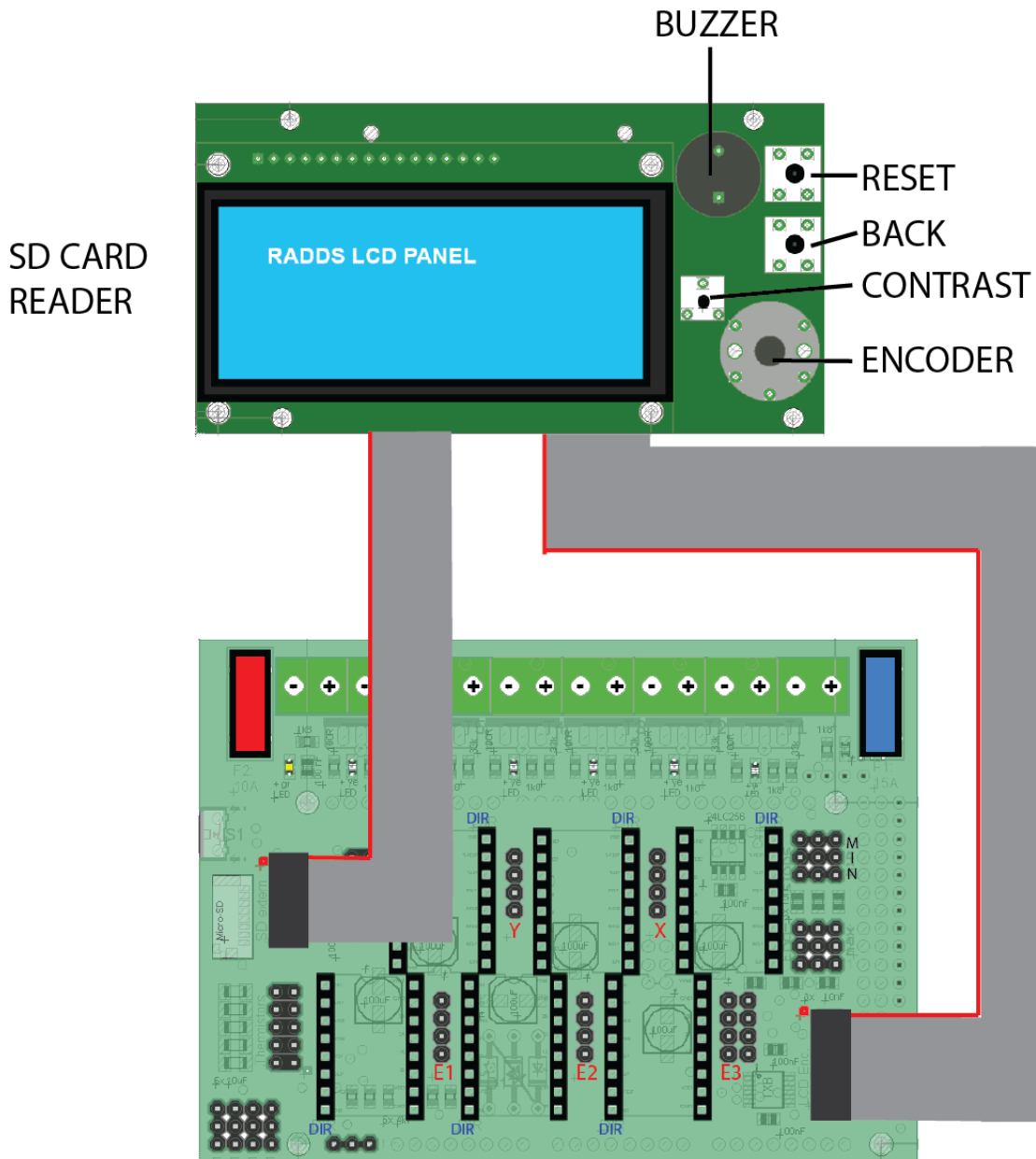


2.1.1 RADDs





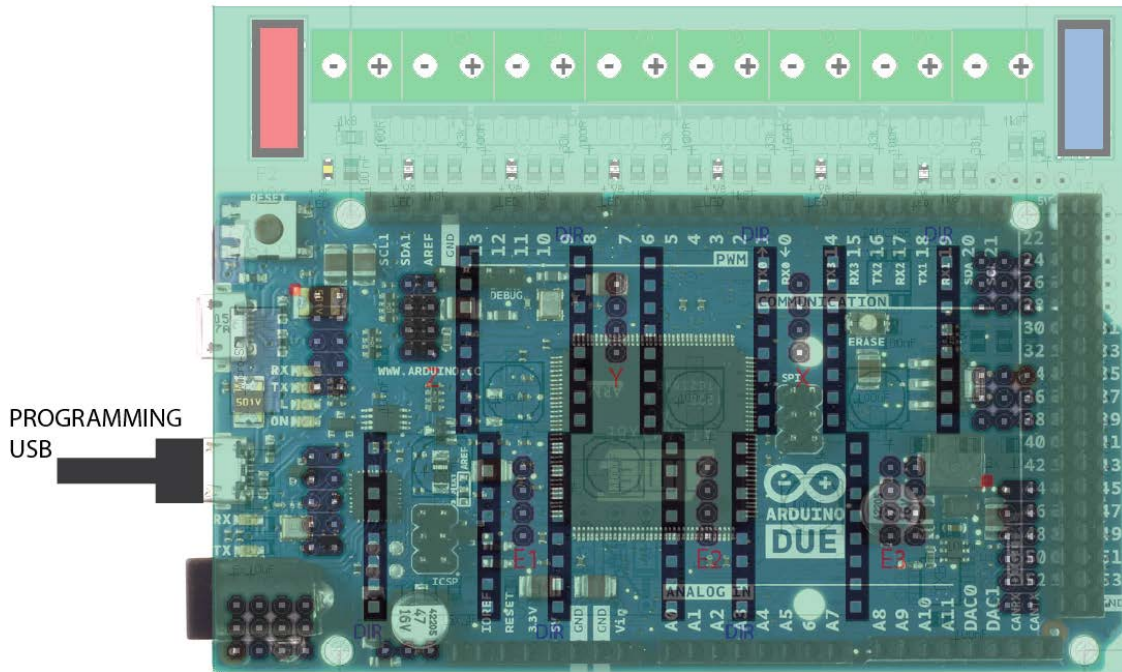
2.1.3 RADDs + LCD



2.1.4 RADDs + Arduino DUE

The Due has a 32-bit ARM core that can outperform typical 8-bit microcontroller boards. The most significant differences are:

- A 32-bit core.
- CPU Clock at 84Mhz.
- 96 KBytes of SRAM.
- 512 KBytes of Flash memory for code.



Mount the RADDs board on the top of the Arduino DUE.

Use the USB Programming port when connecting the DUE to a computer for software update or controlling the printer.

If you want more computer power, the RADDs board can be combined with an UDOO Quad board

<http://www.udoo.org/features/>

The motors plus single hotend take up to 5A or so, a heated bed typically takes 5A-15A. So for a standard setup with heated bed, look to about 18-20A total which is about 220-240W at 12V. For some setups, you might be able to use less power.

More about power supply: http://reprap.org/wiki/Power_Supply

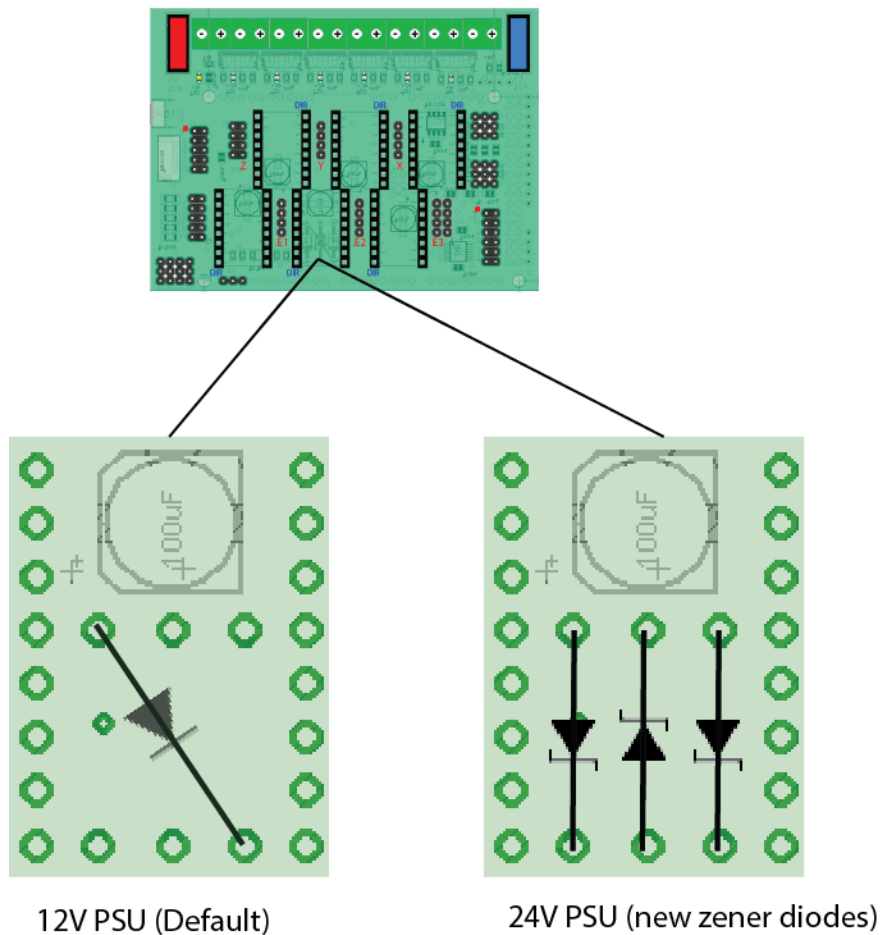
Cables for power supply and heated bed:

16 AWG - PSU and Heated bed (from the PSU to RADDSh heated bed input and from the RADDSh heated bed output to the heated bed)

18 AWG – From PSU to Controller (powers the controller, lcd panel, stepper motors, hotend..)

2.1.6 RADDs powered by 24V Power Supply

If you want to power RADDs by 24V the diode used in the default 12V setup have to be replaced by three Zener diodes (4 V and 1.3W). The three zener diodes then reduces the 24V to 12V that can power the Arduino. It is important that you solder the zener diodes as shown in the image.



The 12V to 24V modification is an option, but not recommended.

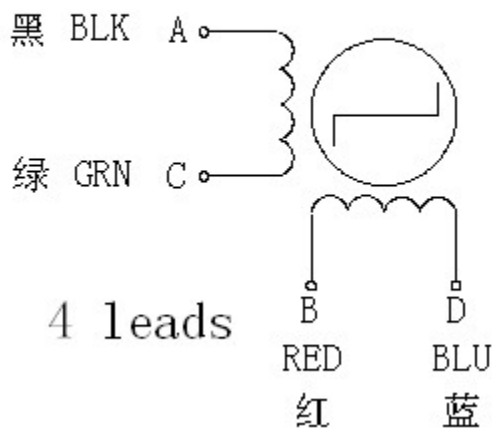
2.1.7 Stepper drivers and motors

2.1.7.1 Stepper motor

Before you can connect the stepper motor to RADDs or Silencioso, you need some information on the stepper motor you have.

Look at your motor, find its part number. Then Google it. Try to find a schematic or a data-sheet that will indicate which wire goes to which pole. Note the colors that correspond to each coil.

Wiring diagram (接线图):



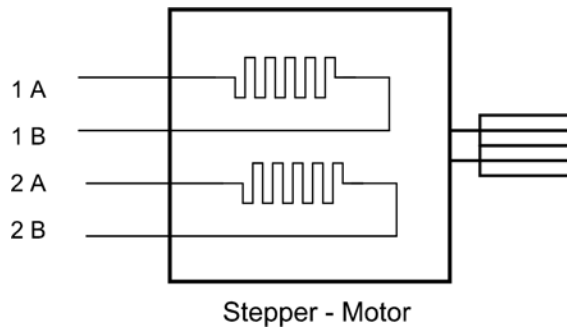
Wiring diagram for Wantai 42BYGHW609 stepper motor (from www.wantamotor.com).

If you can't find the motor's part number, you can use another method to find the motor's pole pairs.

When two wires for a pole (A + C or B + D) touch together it makes a closed circuit for that pole and it gets harder to turn the stepper motor.

1. Try to turn the motor when no cables touch together – it should turn freely.
2. Touch two of the cables together – if the motor gets harder to turn, you have found a pole pair. If not, try to touch two other cables together until the motor gets harder to move.
3. When you have two cables together that makes it harder to turn the motor, you have found a pole pair.

Note the colors for each pole pair (Pair 1 = 1A + 1B, Pair 2 = 2A + 2B)



On the Wantai 42BYGHw609 the colors are:

1A = Black

1B = Green

2A = Blue

2B = Red

It does not matter if you swap the pole pairs. If the motor turns the wrong way, you can reverse it in the configuration file.

2.1.7.2 Micro stepping

A stepper motor always has a fixed number of steps. Microstepping is a way of increasing the number of steps by sending a sine/cosine waveform to the coils inside the stepper motor. In most cases, micro stepping allows stepper motors to run smoother and more accurately.

Microstepping between pole-positions is made with lower torque than with full-stepping, but has much lower tendency for mechanical oscillation around the step-positions and you can drive with much higher frequencies.

If your motors are near to mechanical limitations and you have high friction or dynamics, microsteps do not give you much more accuracy over half-stepping. When your motors are 'overpowered' and/or you do not have much friction, then microstepping can give you much higher accuracy over half-stepping. You can transfer the higher positioning accuracy to moving accuracy too

Source: http://www.reprap.org/wiki/Stepper_motor#Micro_stepping

If you want to alter the micro stepping value on one or more axis, you have to set the correct value. When using Silencioso, you set it using the dipswitches on the Silencioso and modify the values in the configuration.h file

Each time you increase the stepping one level (sample: from 1/16 to 1/32) you have to multiply the steps per unit value by two.

Sample – You are using 1/16 steps per unit and the value is 80 and want to use 1/32 steps per unit.

If your steps per unit value is 80, you have to multiply 80 by two (2x80).

New steps per unit value = 160

```
// #define DEFAULT_AXIS_STEPS_PER_UNIT  
{78.7402,78.7402,200.0*8/3,760*1.1} // default steps per unit for Ultimaker  
  
//#define DEFAULT_AXIS_STEPS_PER_UNIT {80,80,2560,107} // default steps  
per unit for OrdBot 1/16  
  
#define DEFAULT_AXIS_STEPS_PER_UNIT {160,160,5120,214} // default steps  
per unit for OrdBot 1/32
```

This code sample is from Marlin.

The “default steps per unit for OrdBot 1/16” gives you the values for 1/16 micro stepping.

80, 80, 2560, 107

X-Axis = 80 steps/mm

Y-Axis = 80 steps/mm

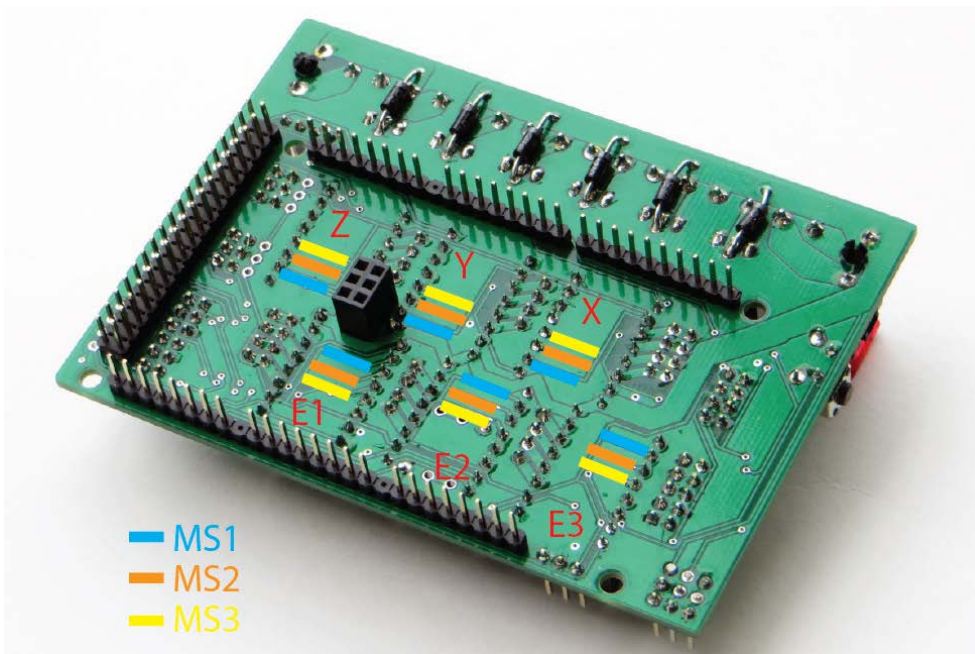
Z-Axis = 2560 steps/mm

Extruder motor = 107 steps/mm (this is the setting for Bulldog Lite Extruder. You have to find the correct setting for the extruder you use)

In the next code line, you find “default steps per unit for OrdBot 1/32”. This is the settings when 1/32 microstepping are used. Here all values have been multiplied with two.

2.1.7.3 Set the micro stepping mode on RADD5 1.1

When you use stepper drivers like the A4988, DRV8825 (NOT WHEN USING EXTERNAL DRIVERS LIKE SILENCIOSO) you have to set the micro stepping mode by cutting or connecting the traces on the back of the RADD5 board.



In this image, the traces have different colors to make it easier to find the correct traces.

A4988			DRV8825			RAPS128			
MS1	MS2	MS3	MS1	MS2	MS3	MS1	MS2	MS3	STEP
L	L	L	L	L	L	L	L	L	1
H	L	L	H	L	L	H	L	L	1/2
L	H	L	L	H	L	L	H	L	1/4
H	H	L	H	H	L	H	H	L	1/8
H	H	H	L	L	H	L	L	H	1/16
			H	H	H	H	L	H	1/32
						L	H	H	1/64
						H	H	H	1/128

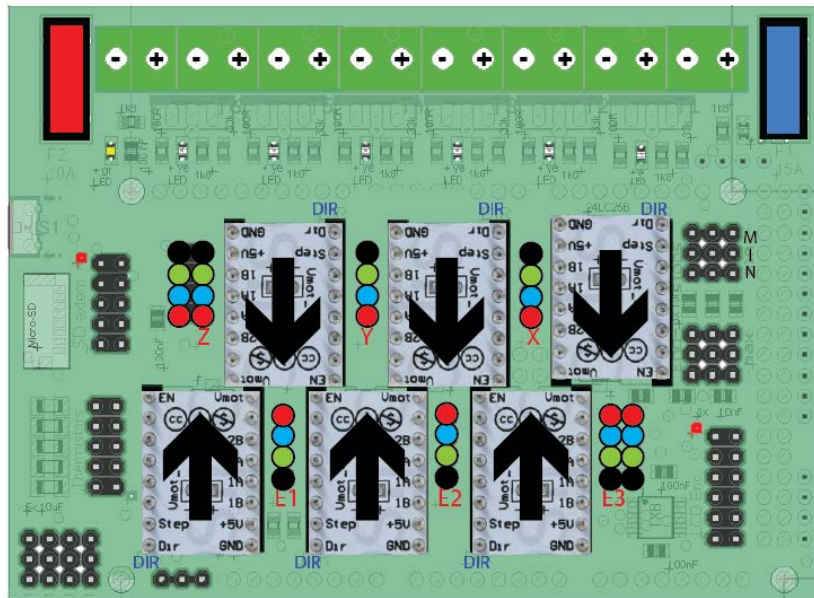
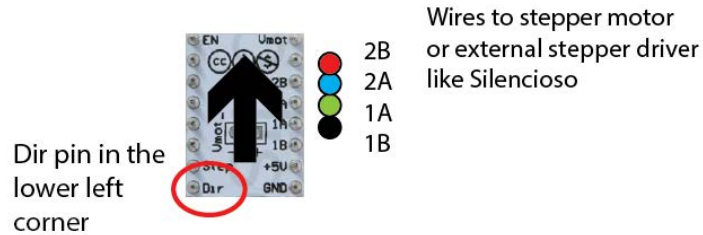
In the table, you find the different stepping modes for the most used drivers.

L = Open trace, H = Closed trace (MS pin = 3,3V = default)

When using the DRV8825 the combinations HLH, LHH and HHH all gives 1/32 STEP

IMPORTANT you have to set the same stepping mode in the configuration.h file and update the controller software.

2.1.7.4 1Mounting stepper drivers like A4988, DRV8825 or stepper driver adapters



Silencioso stepper driver adapters used as a sample in this wiring diagram, but the other drivers have the same pin labels.

Insert the stepper drivers/adapters (X, Y and Z) with the DIR pin in the upper right corner (upside down)

Insert the stepper drivers/adapters (E1, E2 and E3) with the DIR pin in the lower left corner.

The X, Y and Z motor cables have the black wire at the top

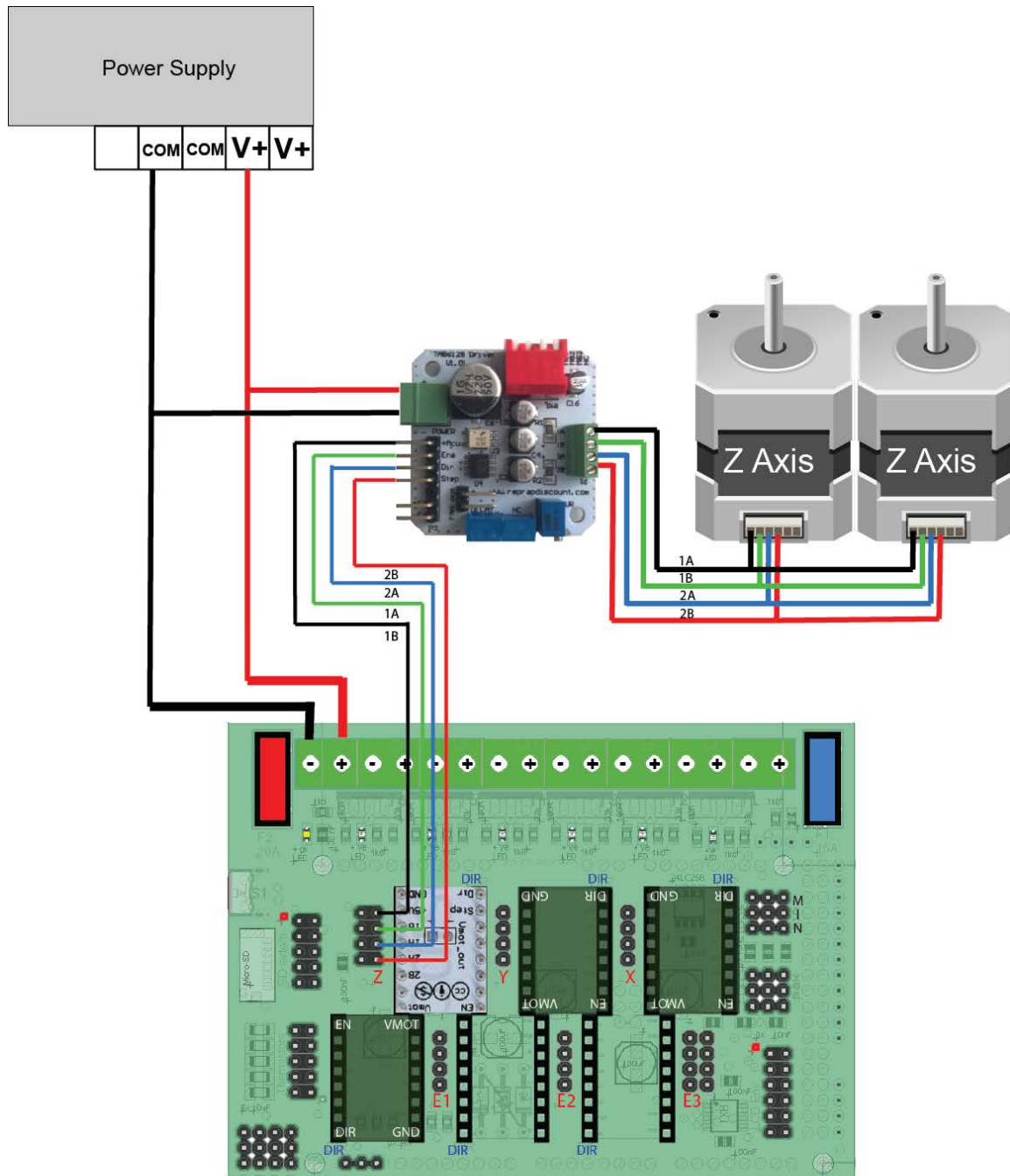
The E1, E2 and E3 wires have the red wire at the top

The Z and E3 have dual motor cable connections so you can connect two motors.

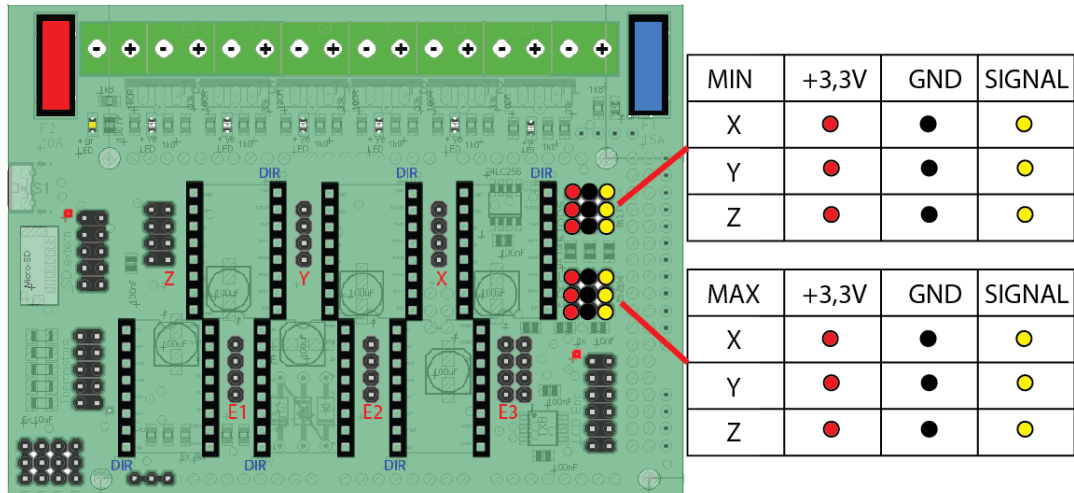
The diagram illustrates the electrical connections for a CNC machine. A Power Supply provides V+ and COM lines. The V+ line connects to the red wire of the X-axis motor and the red wire of the fan. The COM line connects to the black wire of the X-axis motor and the black wire of the fan. The GND line connects to the green wire of the X-axis motor and the green wire of the fan. The Step pins of the X, Y, and Z motor drivers are connected to the blue, green, and red wires of the fan, respectively. The DIR pins of the X, Y, and Z motor drivers are connected to the blue, green, and red wires of the X-axis motor, respectively. The EN pins of the X, Y, and Z motor drivers are connected to the blue, green, and red wires of the X-axis motor, respectively. The VMOT pins of the X, Y, and Z motor drivers are connected to the blue, green, and red wires of the X-axis motor, respectively. The GND pins of the X, Y, and Z motor drivers are connected to the blue, green, and red wires of the X-axis motor, respectively.

2.1.7.7 Dual Z stepper motor alternative 2

This is an option if the total current used by the two stepper motors are lower than the Silencioso max current limit.



2.1.8 RADDs + Endstops

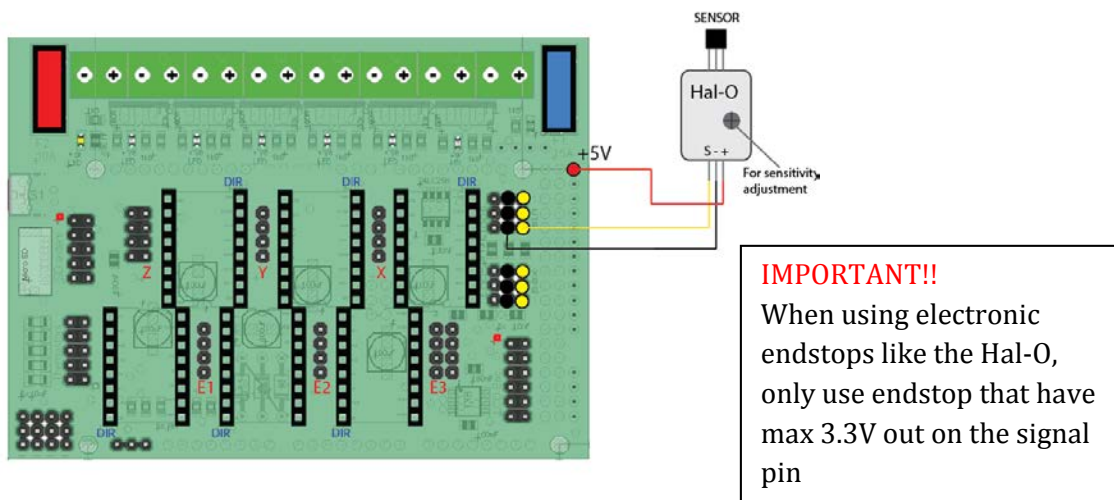


As default there is no pins soldered in the +3.3V as they're not needed when using mechanical endstops.

Mechanical endstops:

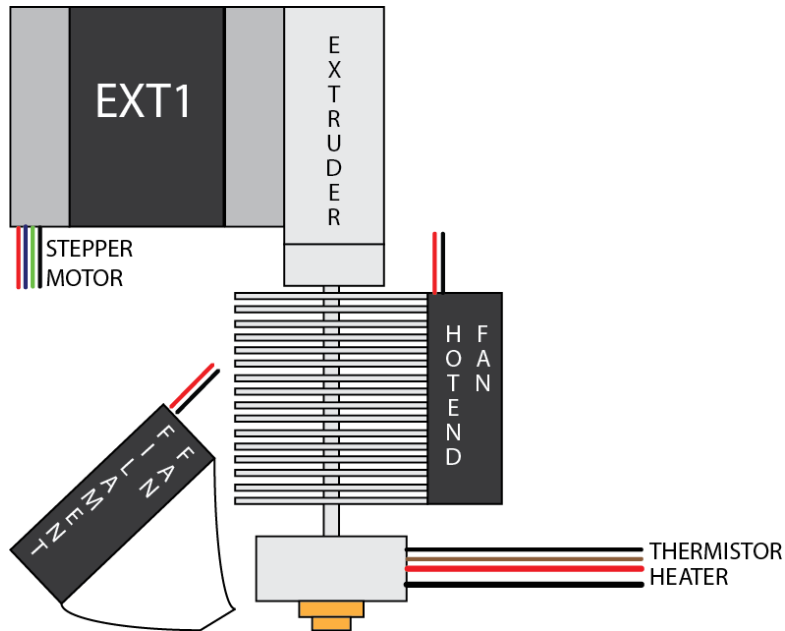
Connect the mechanical endstops to the GND and Signal pins so they are normally closed (push = open)

Hal-O endstops (magnetic):



When using the Hal-O endstops you have to connect the + pin on the Hal-O to the +5V pin.

2.1.9 Connecting Extruder



This image shows a normal direct drive extruder/hotend setup. If Bowden is used the setup is almost the same, but there is a tube between the extruder and hotend.

Wiring:

- Stepper motor to EXT1
- Hotend Fan to FAN 1
- Filament Fan to FAN 2
- Thermistor to Thermistor 1
- Heater to Heater 1

If you have more than one extruder, you must use EXT2, Thermistor 2 and Heater 2 (Hotend Fan and Filament Fan to the same terminals as Extruder 1).

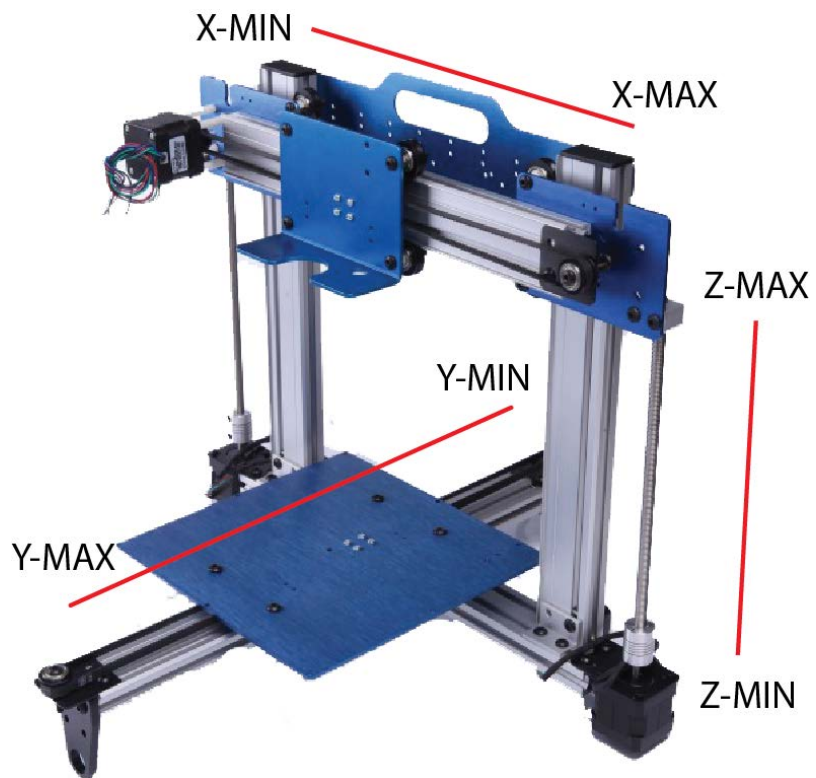
2.2 Wiring sample (OrdBot Hadron printer)

2.2.1 Setup

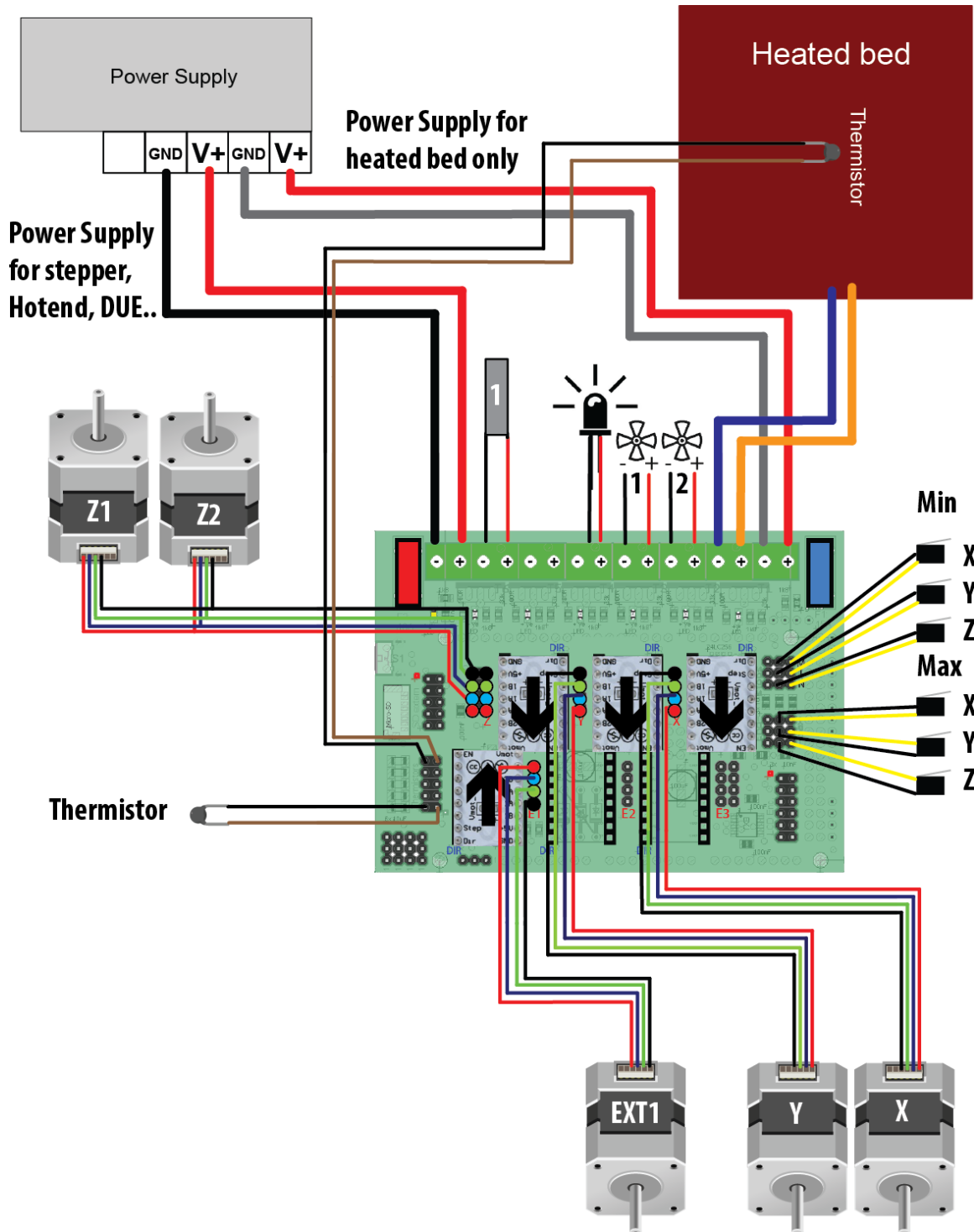
OrdBot Hadron is a Cartesian Printer with separate X, Y and Z-axis.

- OrdBot Hadron mechanical set
- Arduino DUE + RADDs shield
- RADDs LCD control panel
- External Silencioso stepper drivers mounted on the stepper motors
- Mechanical min and max endstops on X, Y and Z axis
- Mk2B heated bed
- Extruder
- Hotend
- Hotend fan (12v)
- Filament fan (12v)
- LED strip (12v) (to light up the print surface)
- 12V PSU
- 1/64 stepping on Z axis and Extruder
- 1/128 stepping on X and Y axis

2.2.2 OrdBot Axis



2.2.3 RADD5 OrdBot Wiring diagram



2.2.4 Installation

- Upgrade the stepper motors with Silencioso stepper drivers (separate user guide)
- Connect the RADDs shield onto the Arduino DUE board
- Install the Silencioso stepper driver adapters (X, Y, Z and EXT1). Make sure the orientation is correct.
- Connect the RADDs LCD control panel
- Connect the stepper motors. In this sample dual silenciosos are used for the dual Z stepper motors (2.1.4.3)
- Connect extruder motor to EXT1
- Connect the hotend heater element to heater element output 1
- Connect the hotend thermistor to thermistor input 1
- Connect the hotend Fan to Fan 1 output
- Connect the filament Fan to Fan 2 output
- Connect the 12V LED strip to heater output 3
- Connect HeatedBed thermistor to thermistor input 4
- Connect HeatedBed 12V to the HeatedBed 12V output
- Connect 12V from PSU to heated bed power input (right side)
- Connect the main power input from the PSU to 12V input (left side)
- Connect the USB cable to the programming port (the one in the lower left corner on the DUE)

IMPORTANT – before you power on your printer for the first time, you must finish the software setup.

Make sure all wiring is correct. If you have connected something the wrong way, you may damage your electronics.

3 Appendices/Notes

- max3dshop: <http://max3dshop.org/>
- RepRap RADDs wiki: <http://reprap.org/wiki/RADDs>
- Martin Henschke: http://www.dr-henschke.de/RADDs_due.html
- Arduino DUE: <http://arduino.cc/en/Main/ArduinoBoardDue>
- Arduino software: <http://arduino.cc/en/Main/Software>
- RADDs case for OrdBot: <http://www.thingiverse.com/mundsen/designs>
- RADDs LCD Case: http://www.dr-henschke.de/LCD_Box.zip